MODULAR TIRE

This application claims priority to and the benefit of U.S. Application Serial No. 60/252,146, filed November 20, 2000.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to an apparatus for the enhancement of Motor Vehicle tires, in the areas of safer operation, greater reliability, better motor vehicle fuel economy, and conservation/up-grading of tire-construction materials.

2. Description of Prior Art

Existing tires have several "Anti-Flat Tire" devices available to Consumers, ranging from "Tire Within a Tire" devices, internal tire wall "Puncture Sealant", and "Rigid Side Wall" structural elements. Existing tires wit "Rigid Side Walls" to keep the tire from going "flat" allow driving a vehicle with these tires, only to be driven a short distance at low speeds. In addition, existing "Tire within a Tire" designs only permit the driver to reach a destination to get assistance, when the tire is damaged to the point of "air loss". In those circumstances, the tire is usually non-repairable and must be replaced. The present invention exceeds existing "Anti-Flat Tire" designs by permitting air loss from punctures to occur only at the location of the puncture, by having a vast number of independent "Air Cells" that far outnumber those of existing tire designs. The present invention has the advantage over existing tires with "Rigid Side Wall" aspects, where this invention uses "Modular" components such as independent "Rigid Side Walls" that allow them to be removed to be repaired or replaced. Every element of the "Modular" tire, such as the "Air Cell"/Inner Tube Segments, "Side Walls", rims, and tire tread

can be repaired or replaced, on a regular basis. This is the purpose and intent of this invention, meaning it is a "Life Time" component having only the parts tat wear, such as the tire tread replaced when worn. Most punctures in the tires don't even have to be replaced because the air loss is "local" and minimal, with respect to the overall function of the tire. Existing tires often burn in accidents, and cause a great deal of flame because of their large amount of combustible material. Certain variations of the present invention use only a small amount of rubber, being the tire tread, as compared to existing tires that are basically all rubber.

One variation of the invention that uses spring-like structures that simulate the shape of a tire has been previously used by NASA on the Lunar Rover, where this vehicle was an electric car that transported the Astronauts over the moon's surface. The present invention uses this concept for a tire combined with a rubber tire tread that is installed over the part of the wheel that contacts the pavement (usually Asphalt), used on existing highways.

BRIEF SUMMARY OF THE INVENTION

A Motor Vehicle (and in some variations Aircraft) tire that will not go flat when cut or punctured. This feature is included with a feature that allows the consumer to keep the tire after the tire tread is worn, and only replace the tread, to continue using the tire. This is done by building the tire in a "Modular" fashion, where the tires "side wall", tire tread, inner tube, air valve, and accompanying rim are separate components, that inter-lock on assembly, to make up the complete wheel. The various types of "inner tubes" used with this "Modular" tire envelope are: individual inner tube segments (approximately 15 sections) that have optional independent air chambers inside

each segment. The air chambers may number from 1 to approximately 12 per inner tube segment, except when an "Air Cell" or "Closed Cell Foam elastomeric material (or equivalent) is used. These "Air Cells" are stuffed inside the tire casing. A unique two-piece rim is installed onto the tire by placing the inside diameter of the rim through the mating opening in the tire. The rim is uniquely split in half so that one half of the rim goes into the tire through the hole of its inside "side wall", and the mating half of the rim passes through the hole in the tire's outside "side wall". The two halves of the rim are then bolted together through a set of mating holes that coincide when the rim halves "bottom" on the tires "side walls", which simultaneously cause the rim's hubs to meet "surface-to-surface". One variation of the "split rim" concept causes the rims and tire's side walls to "squeeze" an inner tube-like core that fills the inside (volume) of the tire. This inner tube is filled with a myriad of "air chambers" that render the inner tube "oversized" with respect to the inside volume of the tire. The individual side walls if the tire, combined with over-lapping bands that match the shape of the tire's tread, allow the "modular" tire tread, individual side walls, and split rims to form a larger volume for the tire to accept the "over-sized inner tube". The entire assembly is "squeezed" down to its normal tire size. Only the "girth" of the inner tube is squeezed because the rest of the inner tube is constrained within the diameter of the tire's tread. The tire reaches its proper inflation pressure via reducing its volume (squeezing its girth) to its "design volume". The squeezing is done via a Hydraulic Press, or equivalent device. The final volume {"design volume") is secured via "special" bolts passing through a circular set of holes in hubs of the rims/mating holes in the side walls, and a circular set of "outboard" holes passing through the tire's side

walls, at their outer edge/mating with holes through the tire tread (in a transverse direction). The bolts that clamp this assembly ("sandwich") together have Acme Threads, or equivalent, that locks the assembly together. These bolts also provide some adjustment of the resulting tire pressure by tightening or loosening the clamped assembly, using a tool to turn these bolts.

Another variation of the Modular Tire that is similar to the one that uses "Air Cells" that are "squeezed" to effectuate inflation pressure, is one having inflatable inner tube segments, where these segments have individually inflatable "cells". Each of these inner tube segment's "Air Cells" have a system of "air filler valves" that pass through the tire's rim. A novel/special air filler nozzle, having an air distribution manifold built into it, fills groups of the tires inner tube segments, simultaneously. This same device can be used to deflate these segments because the "air valves" of each segment have Check Valve components inside them. To inflate the tire, the tire's casing is filled with these inner tube segments (approximately 15 units), that form the shape of a typical inner tube. The tires split rims are then installed. These rims have slots located around its perimeter, that correspond to the pattern formed by the air valves emanating from the inner tube segments. These air valves (approximately 15 "valve stems") pass through the slots in the tire's rim. The hubs of the rims are bolted together, "surface-to-surface, via studs located in one half of the rim, and nuts that that engage these studs which pass through the hub of the other half of the rim. The aforementioned inflation tool has an Air Pressure gauge integrated into its construction, that indicates the pressure of each individual "Air Cell" within each inner tube segment. Filling all of the inner tube segments to the prescribed

pressure is equivalent to filling a conventional tire to its required pressure, per the contemplated design of the "Air Cells".

A similar variation of the invention is a tire having similar inner tube segments, except its "air filler valves" pass through the in-board side walls of the tire. This allows the consumer to use standard/existing rims. The "air filler valves" passing through the surface of the in-board side wall of the tire are not significantly visible, because that particular side wall is made thick enough to hide most of the valve. Only a small amount of the valve is needed near the surface of the side wall in order to allow the air filler nozzle to be inserted into the inner tube segments' "valve stems"., during the inflation process. The inflation tool is used only when the tire is being assembled.

A variation of the invention used as a wheel that is similar to the spring-like wheels used on the Lunar Rover also exists. This variation involves having each of the tire's side wall and one half of its tread molded together. These two halves of the tire go together in a "clam-shell-like" combination to cover the wheel/inner-tube-like structure formed from coiled spring-like material. The aforementioned molded covering is equivalent to splitting a standard tire in half, and adding a pattern of radial "fins": onto the inside surfaces of the tire's side walls. These internal "fins" combined with corresponding set of "grooves" are added to the inside surface of the tire's tread area. The combination of these "fins" and "grooves" are arranged to match and inter-lock with the edges of the spring-like inner tube. This feature makes the spring-like inner tube "drive" the tire similar to the way mating gears "drive" each other.

This entire assembly is attached to a rim that is also "driven" when the rim is attached to the vehicles' axle. The rim is attached to the enter of spring-like inner tube, where its combination resembles the "skeleton" of a tier/wheel assembly. This variation of the invention also involves using unique materials for its spring-like inner tube structure. These materials are: Vulcanized Fiber, Spring Tempered metals such as Steel/Stainless Steel/Beryllium Copper/etc., Polycarbonate (Lexan), Kevlar, Flexible Epoxies, and the like. The Plastic and Vulcanized Fiber material would have an Aluminum foil covering laminated to their surfaces to render them "Fire Proof", or they may be painted with "Fire Proof Paint" that has been recently developed. These structures would vary in wall thickness, with regard to the vehicle's weight and maximum allowable deflection of the tire when it hits bumps or other road obstacles. The plastic "inner tubes" that make up this part of the invention would be molded or formed to have a "memory" and other retention properties that make it keep its shape in contemplated weather and driving conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the Modular tire assembled, with its basic components, being its split rim, side walls, and tire tread.

Figure 2 shows how the side walls are bolted to the tire tread, using long bolts through the tread and captive nuts.

Figure 3 shows the novel tire casing with "grooves" around its circumference, along with the mating tire tread.

Figure 4 shows a variation of the tire's "Anti-Flat Tire" system, using individually inflatable inner tube segments.

Figure 5 shows the inner tube made of spring-like material, and the tire's side wall with "fins" that lock into the tube.

Figure 5A shows a variation of the spring-like inner tube, where the structure serves as the tire's side wall, as well.

Figure 6 shows a cross section of the Modular Tire, or a conventional tire, with the inflatable inner tube segment and its unique Split Rim that allow the air filler valve to pass through the rim.

Figure 7 shows a typical inflatable inner tube segment that fits inside the tire casing, plus its "air filler valve", and seal.

Figure 7A shows the inner tune segment with individually inflatable air chambers and their "air filler valves" within.

Figure 7B, 7C and 7D Show the aspects of the air seal that bonds the two halves of the inner tube segments together.

Figures 8/ 8A/ 8B show the inner tube segment's air inflation tool, and the air check valves in the tube's valve stem.

Figure 9 shows the total tire, having its inner and outer side walls, tread, inflatable inner tube segments, and split rim.

Figure 9A and 9B show how the air filler valve stem is held in place by slots in one half of the split rim.

Figure 9C and 9D show how the array of air filler valves is covered by a decorative cover that is attached over the rim.

Figure 10 shows the tire with an inner tube made of molded-in "Air Chambers", and the mechanism that holds the inner tube/tire into the configuration of a standard tire, after it has been squeezed in a hydraulic press to build pressure.

Figure 10A shows the special bolt that holds the squeezed tire/inner tube in the configuration of a standard tire.

Figure 11 shows a variation of the inflatable inner tube segments that have its air filler valve stems on the side of the

of the inner tube segments, to allow filling them with air though mating holes in the side walls of the tire.

Figure 11A shows the inflation tool used in the configuration of the inner tube segments having valve stems on its side.

Figure 11B and 11C show the details of the inflatable inner tube segment with valve stems on its side, and the cross section of this inflatable inner tube segment installed into a tire with the valve stems passing through the side wall.

Figure 12 shows the invention configured as a Modular tire with individual treads that can be replaced.

Figure 12 A shows the invention with treads that can be replaced that are bolted or pop-riveted onto a Modular tire casing that is made from molded/flexible plastic or metal, that flexes in accordance to road conditions.

Figure 12B shows a Modular tire casing constructed similar to the wheels used in the Lunar Rover, Built by NASA.

Figure 12C and 12D shows a Modular Tire in a "Clam Shell" configuration, and how it is bolted together.

Figure 13 shows the invention as a Lunar Rover-type wheel/ "airless wheel" made from spring-like material(s).

Figure 13A shows the Lunar Rover/"airless wheel" with inflatable "load-carrying boosters"(Foam Rubber or the like) inner tube segments installed inside the spring-like Lunar Rover-type wheel.

Figure 14 shows the inflatable inner tube section that is used as a "load-carrying booster" for the spring-like wheel.

Figure 14A shows one-half of the "clam shell" (the inside chamber) that is used as the inflatable inner tube segment.

Figure 14B shows the "tongue-in-groove" (ribbed edge in channel) method of sealing the two halves of the inner tube

segment (in the configuration of a "clam shell") by pressing or pressing/bonding their edges together.

Figure 14C shows a variation of the inner tube segment ("load-carrying booster") with individual inflatable chambers.

Figure 15 Shows a cross-section of the assembly of Lunar Rover-type wheel, with the "load-carrying boosters" installed inside of the spring-like wheel, and the replaceable tire tread installed onto the outside surface of the wheel.

Figure 15A shows one-half of the "clam shell-type" hub that holds the middle element of the Lunar Rover-type wheel.

Figure 15B shows one of the segments of the Lunar Rover-type wheel, and the mounting hole pattern for installing subsequent segments of the wheel and holes for installing the replaceable tire tread.

PREFERRED EMBODIMENT OF THE INVENTION

Referring now to the drawings and in particular Figure 1, the present invention is shown generally comprised of the replaceable tire tread **1** captured by the tire's side walls **2** and **3** making up the tire casing, which is filled with inflatable inner tube segments **13** and **14**, where the assembly is clamped together by its split rims **20** and **22** having rim-mounted studs **5** and their associated nuts **47** clamping the split rim hubs together. This figure also shows the inflatable inner tube segment's air filler valve stems **9**, **10**, **11**, and **12** passing through slots in the split rim, where the valve stems are held upright and secured by their collars **16** that are bonded to the valve stems.

Figure 2 shows the Modular tire with its tread **1** clamped to the tire's side walls **2** and **3**, using through bolts **7** and their mating captive nuts **8** that are pressed into a hole pattern

around the circumference of the side wall **3**, being on the same axis as the bolt holes for **7** that pass transversely through the tire tread. The figure shows the inflatable inner tube segments **13** , **14**, or **22** and **23**, installed inside of the tire casing.

Figure 3 shows a variation of the invention's the tire casing **6** that has grooves molded transversely around its circumference, that mate with grooves that are molded onto the inside surface of the tires replaceable tread **1**, where these grooves prevent the tread from slipping at the tread/casing interface, when the tire is operating on a vehicle. The tire casing can be made of unique flexible materials and its shape molded by cost-effective molding processes. Examples of this novel situation would be tire casings made by Injection Molded plastics like Polycarbonate (Lexan) or Hydro-formed metals that are spring tempered, or molded fabrics impregnated with flexible resins, where the non-metal shapes can be made "Fire Proof" by laminating a ductile foil "skin" like Aluminum Foil **46** onto their structure.

Figure 4 shows the shape that the array of inflatable inner tube segments **13** and **14** take, when they are installed inside of the tire casing. It also shows the cluster of the inflatable inner tube's air filler valve stems **9**, **10**, **11**, and **12**, located around the inside diameter of the circular inner tube segment array.

Figure 5 shows an inner tube made from spring-like material **39 and 40** similar to the wheels of the Lunar Rover, and the Modular tire's side walls **28** and **29**, that have fins "F" that grip the "inner tube-like" structure to prevent it from slipping when the tire is driven by a vehicle. The inner tube-like structure may also consist of a material made of molded "Air Cells" **19** having similar circular geometry that is clamped between the Modular tire's side walls **28** and **29**, to form the

body of the tire. This assembly is bolted together, along with the tire's replaceable tread through the "C" and "E" holes in the side walls that match up with holes in the tire's replaceable tread.

Figure 5A shows a inner tube-like/side wall structure made from flexible spring-like plastic or metal material **27**, that is clamped to the Modular Tire's replaceable tread **6**, through the "E" holes using the through bolts **7** to secure the side walls to the tire tread, along with through bolts **48** and their mating nuts **49**, passing through the "C" holes that clamp the two halves of the tire's rims **20** and **22** to the same inner tube/side wall structure.

Figure 6 shows a variation of the invention that uses an inner tube segments **13** and **14** having independent inflatable chambers that use a valve stem assembly which has independent air valves **9**, **10**, **11**, and **12** for each air chamber. This figure shows a cross section of the components around the inner tube segments, being the side walls and replaceable tire tread **1**, **2**, and **3**, respectively that are held by the split rims **20** and **22** through bolting these rims together at the surface of their hubs, where the assembly comprises the Modular Tire.

Figure 7 and 7A Show the inner tube segment's components, consisting of left and right air chamber segments **13** and **14** with air filler valves **9**, **10**, **11**, and **12** appropriately located and bonded to the air chamber segment, along with converting the air chamber segments into a closed volume via the seal **17** that fits over the edges of the air chamber segments, and bonded to them. The assembly has a collar **16** that is fitted over the air valve stem assembly and bonded in place. This collar positions and secures the valve stem in slots located in the tire's split rim, to allow the inner tube segments to be filled with air via its inflation tool.

Figures 7B, 7C, and 7D, show the aspects of the air chamber segment **14** and its seal **17**, where the individual air chambers can be repaired when they are punctured even after they have been bonded into a closed volume, by cutting away the original seal **17** that had a wall thickness shown as "W-1" and replacing it with a seal with an "oversized" wall thickness shown as "W-2", where the difference between the two wall thickness is the amount of material that was allowed to cut the air chamber open to repair it. This concept assumes an adhesive would be used at all edges that mate along the internal edges of the individual "air chambers". The inflatable inner tube segment is re-bonded using the oversized seal which compensates for the material that was cut away during the repair operation. This restores the segment to its original size so it can fit inside of the tire casing. Several oversized seals can be made available to effectuate several repair operations. This prolongs the "life" for using these segments. Conventional tires are generally thrown away when their side walls are punctured or cut. The aspect of being able to repair the individually inflatable inner tube segments as disclosed in this figure eliminates this problem.

Figure 8, 8A, and 8B show the aspects of the aforementioned individually inflatable air chambers in the inner tube segments, where an inflation tool **19** allows the individual air chamber's valve stems **9**, **10**, **11**, and **12** to be filled simultaneously or deflated in the same manner via the check valve system **49** located inside each valve stem.

Figures 9, 9A, and 9B show how the split rims **20** and **22** I are installed onto the Modular Tire by sliding into the tire's inside diameter capturing the valve stems **9.10**, **11**, and **12** of the inflatable inner tube segments **13** and **14** through the use of the valve stem collars **16**, that keep the valve stems from being

pushed inside the tire when the inflation tool is pressed against the valve stem openings. The in-board rim half **22** is bolted to the out-board rim half **20** via the rim mounting studs **5** that are pressed into the hub if the out-board rim half **20**, where these studs are arranged to pass through the "B" holes located in the hub of the in-board rim **22**, and locking nuts **49** are installed onto these studs to clamp the hubs of the two rims together. (surface-to-surface). Figure 9 also shows the "A" holes that are used to mount the Modular Tire (wheel) to the vehicle in the conventional manner..

Figure 9C shows the Modular tier's wheel cover **4**, that hides the valve stems after the inner tube segments are inflated. This cover is not needed if the valve stem location is reversed, by having the slots that allow the valve stems to pass through the rim, located on the in-board rim **22** (see Figure 9 for the definition of in-board).

Figure 10 shows a variation of the invention that has its inner tube molded to fit the tire casing, where the inner tube has individual "air cells" molded inside of the body of the tube. The inner tube's girth is purposely designed "over-sized" by the amount "X", as shown in this figure. This tire variation uses "Jacking Screws" **30** and **36**, assisted by a Hydraulic Press (or equivalent device) to squeeze the side walls of the tire together, where the amount of travel "X", is required to squeeze the tire until its split rim hubs **25** and **26** meet "surface-to-surface". The rim hub **26** is part of a "fixed rim", that does not move. The Jacking Screws **30**, are located around the perimeter of the tire's "fixed rim" **26** (this rim has about 15 evenly-spaced "Jacking Screws" and tire's side wall has 15 "Jacking Screws" also). When the movable rim **25** is squeezed until its hub touches the fixed rim **26** the retainers of the "Jacking Screws" protrude past the surface of the hub of the

sliding rim **26** by the amount "X" . These retainers are brought back "flush" to the surface of the hub by backing the "Jacking Screws" out of their sleeves **23**, where these sleeves have internal Acme screw threads and the "Jacking Screws" have external Acme threads machined into the contour of their heads. The "Jacking Screws" lock the rims together when the Hydraulic Press is removed. Figure 10 also shows a spring like device **27** molded into the tire side wall of the tire. This device is a ring-shaped structure that is intended to stiffen/strengthen this particular side wall **32** because it moves inward to squeeze the inner tube containing the "air cells", which resist this movement because of the pressure build-up inside of the "air cells". This stiffener **27** is shown in Figure 12A more clearly., where the side wall is removed.

Figure 10A shows the "Jacking Screw" **30** and **36** having the Acme screw threads ("T") machined into the contour of the screw head and machined inside of the threaded sleeve **23**, respectively. The threaded sleeves are fixed to the rim of the wheel **26** and fixed inside of the holes around the perimeter of the side wall **2** as shown in Figure 10, or may be seen as "C" holes and "E": holes in figure 5A, where the stiffener **27** is also shown more clearly.

Figures 11, 11A, and 11B show the aspects of an array of inflatable inner tube segments **33** and **34** that differ from those shown in Figure 10, by having their valve stems located on the side of the inner tube segments. This circular array of inflatable inner tube segments can be placed inside a tire casing having a matching hole pattern as the valve stems shown **9**, **10**, **11**, and **12**, where the material around these holes is reinforced. These holes would be usually located in the side wall of the tire that is regarded as the in-board side wall. The inner tube segments would be inflated, using the tool like the

one shown in Figure 11A, where all of the "air cells" of each inner tube segment is inflated simultaneously. This tool may have an Air Pressure Gauge as an integral part, to assure proper inflation pressure.

Figure 11C shows the inflatable inner tube section mounted inside a tire. The tire may be either a Modular Tire as defined in this invention disclosure, or a Consumer's (existing) tire that has been "re-worked" by adding the hole pattern for the valve stem pattern that matches the circular array of inflatable inner tube segments. This figure shows valve stem retainers **50** that are installed after the inflatable inner tube segments **33** and **34** have been installed into the tire casing. These retainers also keep the valve stems from being pushed inside the tire by the inflation tool **19** as the inner tube segments are being inflated. This figure also shows an undercut "U" at the upper end of the inflatable inner tube segment. This undercut is to allow these inner tube segments to be installed inside conventional tires (after the valve stem hole pattern has been drilled into the tire's side wall), using the tools that are used with a conventional Tire Mounting Machine. This means the consumer can use his own conventional rims **15** un-modified, and his own tires that are slightly "re-worked" (modified via adding the valve stem holes), not having to discard or sell them.

Figure 12 shows the invention having novel replaceable treads **38** that are attached to the tire casing via fasteners such as "Nylock" (self-locking screws) Screws. This figure shows the replaceable treads also being "anchored" by Anti- slip fins "F" (or the like) that are molded into the replaceable treads, and the tire casing.

Figure 12A and 12B show another type of replaceable tread **38**, that is secured to the tire casing **6** by "Nylock" Screws (or the like). The figure shows the spring-like side walls **27**

similar to the tires used on the Lunar Rover, to make up a Modular tire that should be able to operate on paved roads, due to the tire's replaceable tread feature. Figure 12 B also shows a type of tire similar to the one used in the Lunar Rover, except its hollow tire casing structure **39** and **40** is made Vulcanized Fiber (a tough, flexible, in-expensive material, or a moldable/spring-like material similar or equal) that is covered with Ductile Aluminum Foil **46** that makes the casing "Fire Proof", and able to be colored with many "Cosmetic" finishes.

Figure 12C shows the Modular tire in a "clam-shell" configuration, where the tread and part of the tire's side wall are molded together. These two "shells" **51** and **52** can be attached to the aforementioned Lunar Rover-type tire casings or the reinforced rubber-type casing **6** shown in Figure 3, or the like.

Figure 13 shows the detailed aspects of the Lunar Rover-type wheel, where it has three spider-like "spring action" elements, being a central spider **54** "captured between two outside spiders **53**, using pop-rivets or the like to hold the assembly together at the "SP-1" holes, located around the assembly's outer perimeter. A pair of center hubs **58** is bonded or welded to the central spider **54** to allow the wheel to be mounted to the contemplated vehicle.

Figure 13A shows this Lunar Rover-type/ "spring-action" wheel being converted from an "airless" wheel to one assisted by the inflatable inner tube-like segments **55** shaped like bellows. These bellows are placed into the spring section of the central spider to give the springs of the central spider more load-carrying capability. These bellows may have a "fixed" inflation pressure by being a single "air Cell" that is inflated at the factory, or may be a variable inflation pressure system by

having air valves and individually inflatable "air cells" in each inner tube-type segment.

Figure 14, 14A, 14B and 14D show the inflatable inner tube-type segment **55** and **56** with air filler valves **57**, **58**, and **59** passing through the walls of the "air chamber(s). Figure 14B shows the aspects of the "tongue-in-groove" edge seal along the mating edges of the bellows, that result from the "clam shell" configuration that the bellows were molded into. The air-tight seal along the edges of the "clam shell"-type bellows is accomplished by a "press fit" that forces the "ribbed" bead along the edges of one half of the "clam shell" (called the tongue) into the ribbed channel along the edges (called the groove) of the mating half of the "clam shell" (bellows). This seal may be a "dry seal", relying only upon the friction and bearing pressure created at the tongue-in groove interface, or an adhesive may be applied to the tongue-in-groove, to effectuate the "air-tight" seal. The splitting open of the "clam shell" and subsequent re-sealing, can be done by cutting the unit apart along the seal, and re-sealing it with an adhesive, if an adhesive is initially used. If no adhesive is used, the unit may be pulled apart, and resealed by pressing it together.

Figures 15 and 15A shows a typical cross-section of the Lunar Rover-type Modular Wheel assembled. The basic elements of this wheel are the outer spiders **53**, the center spider **54**, the split wheel-mounting hubs **58**, the replaceable tire tread **6**, the segments of the Lunar Rover-type tire casing **40** and **41**, and the array of Nylock fastening screws **59** that are used around the perimeter of the replaceable tire tread. Figure 15B shows the mounting holes "TR" that are used to attach the Nylock fasteners to the [tire tread/Lunar Rover-type wheel segments. Figure 15B also shows the mounting hole pattern, designated as "LM", that is used to attach/construct the Lunar Rover-type tire casing, by

pop-riveting (or the like) consecutive tire segments **40** and **41** together to for a circular tire casing. The pre-defined split rim (pre-defined in other variations of the invention) mounts to the Lunar Rover-type wheel at the circular hole pattern defined in Figure 15B, as "W" holes, where each half of the split rim mounts through this hole pattern from opposing sides of the Lunar Rover-type wheel assembly, as shown in Figure 15, where the split rims **58** are shown on each side (left and right side) of the tire casing.

The instant invention has been shown and described herein in what is considered to be the most practical and preferred embodiment. It is recognized however that departures may be made therefrom within the scope of the invention and that obvious modifications will occur to a person skilled in the art.

Some of the advantages of the present invention include, but are not limited to, the following:

1. The Modular Tire has a re-useable tire casing because it never comes in contact with the pavement.
2. The invention has a replaceable tire tread that can be easily installed by removing the fasteners that hold the tread to the tire casing, and that these tire treads are further secured to the tire casing by having 'grooves" and "fins" or the like to provide non-slip surfaces between mating surfaces of the tire's components, that may experience dynamic forces while operating.
3. The Modular Tire invention has variations of the method that the tire does not "go flat" or "blow out", ranging from: (1) inner tube-type components mounted inside the tire casing, where each inner tube-type segment has independent "air cells", (2) "airless" tire casings made from formed "spider-like' structural members, assembled into a wheel, that have spring-like characteristic that

are patterned after NASA's Lunar Rover wheels, but have a replaceable tire tread and have "ride characteristics" that are similar to those of conventional inflated tires.

4. This "airless" Lunar Rover-type wheel has a variation which has inflatable inner tube-like "bellows" that are used to increase the tire's resiliency and load-carrying capability.
5. The invention aspect of having replaceable tire treads has a feature that allows the used tread to be continuously "re-treaded" and re-installed. This is accomplished by using a matrix of self-locking "Nylock" Fasteners (a thread-locking screw, or any similar positive-locking/"quick disconnecting" fastener that a Technician, working for a Tire Company or Tire Dealer, can remove/re-use to remove the worn tire tread and replace with a new tire tread element.
6. The invention also includes tire tread elements that might be an innovation in the tire industry. These replaceable tire treads are composed of only the basic part of the tire that contacts the road. This could save weight and cost, as compared to conventional tires.
7. The invention's replaceable tire tread aspect allows many types of tire tread elements to be installed onto the same tire casing, for example treads designed for Rain, Mud and Snow, High Speed, Long Wear, Racing, and most of the popular other applications associated with the types of tires sold, commercially.
8. The invention can be also used for some aircraft applications. This would increase safety in "take-off "and landings, and save the airplane owners money because of the invention's replaceable tread aspects.

9. The invention has internal components such as "air cells" can be combined with its novel tire casings, where these tire casing variations and aspects result in having spring-like characteristics of conventional inflated tires, but feature a novel use of new, light-weight, inexpensive, non-flammable materials, that are not used in existing tires. The "air cells" used in the "modular tires" of this invention can be either "fixed air pressure" like the "air cells" of closed-cell Foam Rubber or Plastic, or the "air cells" can have variable air pressure through its inflatable "air cell" inner tube-type segment variations.

10. The invention has a variation of its Modular Tire that derives tire inflation pressure from squeezing an "oversized" inner tube-like structure that has its own internal matrix of independent "air cells", and the amount of required air pressure is adjusted by tightening or loosening the matrix of Jacking Screws, located around the perimeter of the tire tread perimeter and rim. This variation has the "anti-flat-tire feature designed into its over-sized "air cell inner tube", where these "air cells" are so numerous that only a few are punctured if the tire encounters normal road hazards that are related to flat tires. Another novel feature of this variation is the tire never has to be repaired because only a few of the "air cells" were affected. These "air cells" can range from closed cell Foam Rubber, Bubble Wrap, and the like, to precision molded inner tube-type segments that are inflated via a filled valve having multiple nozzles.

11. The invention has a novel "multi-cell air filler valve" design and corresponding "multi-cell air filler tool/nozzle" that allows many "air cells" to be filled

simultaneously. This tool can be arranged to fill the individual cells of each inner tube-type segment simultaneously, or it can fill all of the segments of the wheel (tire mounted to its rim) simultaneously by assembling these air filler tools into a matrix/manifold that matches the air valve pattern of the various configurations of the Modular Wheel in this invention.

12. The invention can be used to convert a consumer's existing tires into "anti-flat tire" units by having a unique variation of invention's inflatable inner tube-type segments and accompanying split rims, designed for tires existing in the present industry, installed into their tires. The inner tube-type inflatable segments can be transferred to subsequent tires, on a continuous basis, and the segments are repairable, with respect to punctures in the individual inflatable segments. These segments can be removed from the tire and opened up to patch the "air cell", in a method similar to repairing conventional inner tubes. The inner tube-type segments have a unique "clam shell"-type design that allows them to be opened along their seam for repair, and subsequently re-sealed, and then re-installed into the tire casing.

13. The invention has the re-sealing capability of each of the aforementioned "clam shell"-type inflatable inner tube segments by either using the appropriate adhesive along the edges of the mating "clam shell", or employing a unique sealing feature that uses a "ribbed tongue-in-groove" configuration along the edges of the "clam shell" that allows the edges to be pressed together and locked by friction/bearing pressure. The locking feature is reversible, where the "clam shell" can be pried open via

a tool or by hand, to effectuate repair from punctures. The urgency of effectuating repairs is not significant because each Modular Tire, having the aforementioned inflatable inner tube segments installed into the tire casing has a great number of cumulative "air cells" inside the tire, and a puncture in one or a few of the "air cells" should barely affect the Modular Wheel's performance, when installed onto a vehicle.

14. The invention has design aspects to also allow a customer to use his existing rims (wheels) with a modular tire that has the unique variation, where the tire is composed of the circular array of inflatable inner tube-type segments with the air filler valves passing through the side walls of the tire. It may also be possible to convert a consumer's existing tires to this configuration by "drilling" the hole pattern for the air filler valves into his tires. The structural integrity of the modified side wall would not be critical because the individual inflatable inner tube-type segments do not depend upon the tire's side wall being "air tight".

15. The inflatable inner tube-type segments can be inflated by the aforementioned air filling tool, or it can be inflated using a "needle' (or "needle matrix") combined with a "tire sealant"-type coating on the inner walls of the individual :air chambers", that allows them to be filled at the factory or Tire Dealership. The sealant would eliminate repairs from most punctures in the "air cells", associated with use on a vehicle.

16. The Modular Tire that has a wheel cover to hide the circular matrix of air filler valves passing through its rim, may also be used without the wheel cover if the wheel is mounted to the vehicle with these valves facing

in-board, where the valves would not be visible. Once the tire is inflated, the need for access to these valves is rare, and the elimination of the covers saves weight, with respect to the wheel.